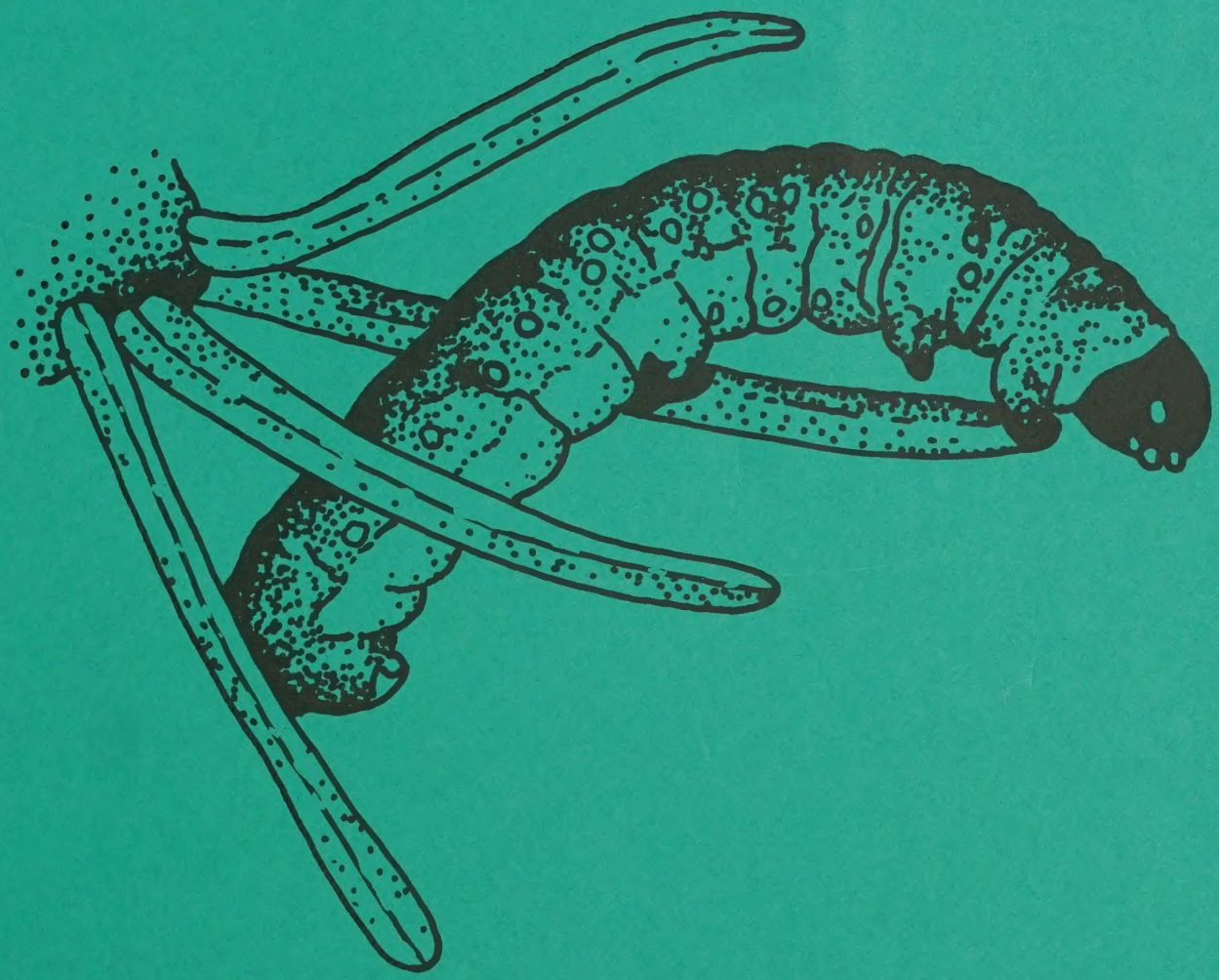
Management

Pacific
Northwest
Region

Final Environmental Impact Statement Summary

Management of Western Spruce Budworm in Oregon and Washington



Final Environmental Impact Statement for

Managing Western Spruce Budworm In Oregon And Washington

USDA Forest Service
Pacific Northwest Region
States of Oregon and Washington and Portions of California and Idaho

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SUMMARY

Introduction

The Pacific Northwest Region (Region 6) of the USDA Forest Service is headquartered in Portland, Oregon. It includes Oregon, Washington, and parts of a few Counties in California and Idaho. In Region 6, the Forest Service administers 19 National Forests (including 1 National Grassland) totaling 24.5 million acres. Terrain and vegetation vary widely across the Region. There is a great variety of landforms, from coastal dunes and flat grasslands to rolling hills, steep ridges, mountains, and volcanoes. Natural vegetation ranges from the Olympic rain forest to interior high deserts.

This summary of the Environmental Impact Statement (EIS) discusses the issues and concerns raised by the public and other agencies, and Forest Service personnel regarding management of the current western spruce budworm infestation. After carefully considering comments, the Final Environmental Impact Statement has been prepared and issued. This final version is the basis for selection of a program for managing future western spruce budworm infestations in National Forests in the Pacific Northwest.

Current Situation

Various plant communities on the east side of the Cascade Range have been experiencing an ongoing infestation of western spruce budworm. Douglas-fir, grand fir, white fir, Engelmann spruce, subalpine fir, and western larch are the primary source of food for western spruce budworm. The spruce budworm is capable of consuming and destroying much of the new foliage on these trees. The result is vast areas of brown defoliated trees, some of which could eventually die. Although western spruce budworm is always present in the forest, a high level of budworm activity has been reached and the associated damage has caused considerable concern to forest landowners and other National Forest users. Efforts to control the current infestation could have important consequences on the social, biological, and physical environment.

Description Of The Insect

The western spruce budworm, (*Choristoneura occidentalis* Freeman), is the most widely distributed defoliator and potentially destructive insect of coniferous forests in western North America. The adult is a small orange-brown mottled moth. The destructive feeding period is during the caterpillar (larval) stage of the insect. The insect's population levels are usually held in check by the interaction of parasites, predators, timber stand conditions, and weather. Periodically, the complex of natural controls no longer limits growth of budworm numbers and an outbreak occurs.

At epidemic levels, budworms may defoliate entire timber stands, feeding primarily upon new needle growth. Outbreaks typically last from 6 to 10 years, resulting in five types of damage to host trees: growth loss, top-kill, deformity, reduced seed production, and mortality.

In Oregon and Washington, the budworm completes one cycle of development from egg to adult each year. Following flight in late July and August, the adult moths lay eggs that soon develop into tiny larvae which overwinter in an inactive state in sheltered places under bark scales and among lichens on tree boles or limbs. In early May to late June, larvae emerge and begin their active feeding stage. As rapidly growing larvae, spruce budworms molt (shed their skin) a total of five times. The six intervening stages are called instars. After about 30 to 40 days, larvae develop into pupae. The moths emerge from the pupae after about 10 days to begin the cycle again.

Scope of the Decision

The scope of considerations described in this EIS will provide the responsible official with a basis for deciding which strategy, if any, should be used to manage the current epidemic of budworm infestation.

During the public involvement process, concern was expressed as to what could be done to reduce damaging infestations long term. These solutions consist of silviculture manipulation of a stands

composition to reduce the amount of host species present. Generally, the USDA Forest Service is in agreement with the use of these means. However, the spruce budworm is only one of many insects and diseases to be considered in management strategies for dealing with the future health of forests. Complex interactions of forest insects and diseases exist in all forest plant communities. A management strategy for control of one insect or disease may increase or decrease the effects of other insects and diseases. It may also effect the needs or outputs of other forest resources.

The Forest Service does not presently have the computer modeling capability to make long-term strategic decisions for management of the insects and disease complex. In addition, techniques do not exist to integrate these decisions with resource allocation decision that are made during development of the Forest Plans. The Forest Service is committed to have this capability within the foreseeable future.

In addition, silviculture solutions will take decades to implement and thus, be ineffective towards the present infestation. Since the scope of this EIS is limited to treatment of the current infestation, long term silviculture treatments were precluded from consideration.

The decision which is reached from consideration of this FEIS will be applied to areas throughout the Pacific Northwest Region, where direct suppression of western spruce budworm infestations appears to be warranted. Site specific analyses will be conducted within individual management units, to consider the possible effects of proposed treatments. Environmental analysis will be conducted and the appropriate disclosure documents prepared.

Public Involvement

Meetings to help identify public concerns have been conducted with Government agencies, Special interest groups, industry representatives, and interested individuals.

A scoping brochure requesting comments and concerns was mailed to approximately 2,000 groups and individuals to help identify Issues and concerns. Press releases were mailed to the media near areas where western spruce budworm infestations have been documented. A total of 206 responses were received through distribution of the brochure and included approximately 550 substantive comments. These comments were analyzed to identify issues, proposed Alternatives, and viable analysis criteria needed to evaluate the possible Alternatives.

In October 1988, a Draft Environmental Impact Statement (DEIS) on the management of the western spruce budworm in Oregon and Washington was printed. Approximately 1000 copies of the DEIS and 2000 copies of a Summary were mailed to interested parties. A total of 101 responses were received through distribution of the DEIS and Summary and included approximately 1244 substantive comments. These comments were incorporated into the Final Environmental Impact Statement.

Major Issues And Concerns

In the years since 1981, when budworm infestations reached readily verifiable epidemic proportions in the Region, Environmental assessments (EAs) have documented a growing concern for affected resources and for the effects of chemical suppression efforts. Issues and concerns identified during a 1984 northeastern Oregon analysis were used to help generate public involvement in 1985. 'Scoping' efforts in 1986 included public meetings and written inquiries to concerned citizens. In 1986, 1987, and 1988, public meetings were held by individual Forests. In addition, letters were written to interested parties, to elicit and identify issues and concerns that had not been specifically addressed in previous EAs. Public meetings, personal interviews, news clippings, and written correspondence resulted in identification of public issues and management concerns. The Issues identified by these means reflect the views of concerned individuals, forest-based industry representatives, landowners of various-sized forest holdings, forest resources user groups, conservation and environmental groups, Native American tribes; as well as representatives of local, State, and Federal agencies and governments.

Based on responses to mailed inquiries; and concerns identified in a broad sampling of past EAs, major public Issues were identified in the scoping process conducted for this EIS. A discussion of these issues follows:

Silviculture

The effects of budworm infestations on timber production are complex, whether treatment is initiated or not. Long-term management of timber stands through silviculture treatments as a means to end the epidemic is an Issue. Western spruce budworm suppression efforts would only serve to lessen short-term growth losses. However, any long-term solution will take decades to implement and thus ineffective in treating the present outbreak.

Concern has been expressed that untreated budworm infestations may negate efforts to increase timber growth rates through intensive timber management, and that long-term yields and harvests may be reduced from present levels. It has been suggested that budworm suppression using insecticides will be needed until areas contain healthy, mixed-species stands which are less vulnerable to budworm infestation. There is concern that past silvicultural practices have led to species composition and stand conditions that are more vulnerable to spruce budworm infestations and resulting damage.

Water Quality/Quantity

Two broad areas of concern are included in this issue: possible hydrologic changes that might occur in watersheds if the budworm epidemic is left unchecked, and possible contamination of water quality from the use of insecticides. Some members of the public have asserted that widespread defoliation may result in variations in the quantity of water yield in heavily affected watersheds; that increased flows could result in streambank cutting and greater sediment loads. Hydrologic changes could also affect unstable slopes and cause increased mass failure activity.

A number of people are concerned about monitoring activities. They believe that monitoring should be adequate to assess the short-term and long-term effects of treatment on water quality and riparian zones.

Most concern about possible water quality diminution centers on the use or accidental spills of chemical insecticides. The nature of ingredients in *B.t.* formulations and the use of spreader/sticker agents in this biological insecticide are also a concern. Individuals have expressed concern about possible adverse effects on aquatic life and irrigation water. However, the central issue involves direct human use of water that may contain insecticides. Protection of water quality in Oregon and Washington municipal watersheds, such as those of The Dalles, Dufur, and Walla Walla, is of great concern.

Fire and Fuels

Many years of effective fire suppression have resulted in unprecedented accumulations of needle litter, dead limbs, and dead trees; which can lead to high intensity wildfires. Infestations of mountain pine beetle, western spruce budworm, and Douglas-fir tussock moth have also contributed to fuel loads. Recent insect epidemics have increased the rate of accumulation.

Fish, Wildlife, and Domestic Animals

People are concerned that fish, wildlife and domestic animals could be adversely affected by the budworm infestation or by insecticide application.

Big game species may be affected if budworm defoliation changes the quantity and/or quality of the coniferous overstory which is used for thermal cover, hiding, and escape. Some people expressed concern that deer and elk may be adversely affected by ingesting insecticides on forage. Since spraying of insecticides usually occurs about the same time as spring birthing, some people express concern about the effects of increased human disturbance (increased desertion of young, increased vulnerability to predation) during this critical biological activity. Bighorn sheep deserting their young as a result of human disturbance was a concern mentioned in particular.

Concerns were also expressed about possible adverse effects of insecticides on vertebrate species (birds, small rodents, and squirrels) that consume budworms and other insects. While insectivorous bird species were mentioned most often in this regard, concern was also expressed for several species of raptors, geese, flying squirrels, bats, toads, lizards, salamanders, and snakes. Other concerns were expressed for federally classified threatened or endangered species, and that a reduction in food supply for several species could cause relocation and reduction in nestling survival.

Concerns were expressed about possible adverse effects of insecticides on natural predators of the budworm, which might upset the natural balance and result in a need for yearly treatment. Possible adverse effects on pollinator species and livestock were also a concern.

Many people expressed a strong desire for monitoring programs to better assess the direct and secondary effects of insecticide application on nontarget species. These data would then provide a better source of information upon which to base future budworm suppression decisions.

The same concerns described for terrestrial wildlife were also expressed for aquatic wildlife. The greatest concern involved possible adverse effects to fish (native and anadromous), either through direct exposure to insecticides or through reductions of aquatic insect food supplies. The safety of human consumption of fish from oversprayed streams was also a concern. Many people believe stream buffers are the only measures used to protect aquatic resources. The need for monitoring direct and secondary effects was emphasized.

Scenic Values/Recreation Use

The potential impact of spruce budworm damage on scenic viewscapes is a concern to many people. A reduction in recreational use (campgrounds, picnic areas, fishing, hiking, etc.) due to spruce budworm infestations is an Issue, as are the economic implications of these reductions.

Economics

Nearly all members of the public want to know if their money is being spent wisely. Most have suggested that the benefits and costs of Alternatives being considered should be displayed and compared. Opinions have been expressed regarding factors that should enter into the economic efficiency analysis and the appropriateness of assumptions used in past analyses. Benefits and costs associated with the following factors have been suggested for consideration: timber growth loss, effectiveness of *B.t.* compared to carbaryl, risk of budworm population resurgence or reinvasion, and reduced recreation use.

Concerns have been expressed for the possible economic effects on private landowners if a "No Action" decision were made. Where private land is adjacent to designated Wilderness, for instance; will policy not allow for treatment of infestations?

Concern has been expressed for possible reductions in National Forest timber harvest levels because of the budworm outbreak, and subsequent effects on employment and community stability.

Human Health

Most people who have expressed concern with budworm control projects want an understanding of possible hazards associated with the use of the insecticides being considered. The potential for long-term, short-term, and cumulative effects on human health is a concern. Possible effects on pregnant women, children, older people, and chemically sensitive people have been mentioned.

Most people believe high priority should be placed on preventing accidents and spills, and that if mishaps occur, the response should be swift and appropriate. Timely public notification should be given so people can avoid treatment areas. Emphasis on safety should be given throughout contract preparation, contract administration, and all operational aspects of a spray project.

Many of the people showing an interest in budworm control programs expressed a preference for continued biological rather than chemical insecticides. There are concerns about cumulative health risks from existing chemical use in the environment, and that additional chemical pesticide applications will add to human health hazards.

Effectiveness of Treatment Methods

The effectiveness of insecticides is dependent upon application techniques and proper timing. The efficacy of a biological insecticide is more dependent upon weather conditions than chemical insecticides. Unlike chemical insecticides, biological insecticides must be ingested by western spruce budworm larvae to be effective. Treating too early can result in many individual larvae escaping exposure to *B.t.* Because they are not feeding on foliage that is exposed to the spray of *B.t.*, the effectiveness can be diminished by exposure to sunlight before being ingested by larvae. Treatment administered too late might result in avoidance of *B.t.* by larvae that have advanced into the late sixth instar and have ceased feeding prior to pupation.

Timeliness of Treatments

Throughout its range, detectable populations of the western spruce budworm appear to persist indefinitely in stands that contain a substantial proportion of suitable hosts. Some people felt that immediate suppression action could limit the spread of an infestation and prevent a widespread outbreak.

Planning Questions

Analysis of public responses shows that many of the issues and concerns were interrelated to some degree. Those most closely interrelated have been grouped into eight planning questions.

1. What are the hydrologic effects of treatment/nontreatment?

Concerns have been raised regarding the effects of the western spruce budworm infestation upon water quality and quantity. Some feel defoliation and tree mortality influence snowpack levels, seasonal snowmelt, stream temperatures, turbidity, overland flows, and increased sediment associated with salvage of mortality is also a concern.

2. What is the effect of budworm treatment or nontreatment on the potential for wildfire?

As needles, branches and entire trees drop to the forest floor, fuel loading increases. What is the likelihood and potential impact of an uncontrolled fire event under the various management options?

3. What are the effects of each alternative on fish, wildlife, and domestic animals?

Concerns that increased human disturbance associated with suppression projects upon deer and elk during fawning and calving have been raised. Some people feel that fawns and calves would be more vulnerable to predation because of increased chances of desertion by the mothers. Bald eagle nesting territories occur within infested forests. There are concerns about the health effects on wildlife resulting from use of *B.t.* or carbaryl.

4. What is the effect of budworm treatment or nontreatment on scenic values and recreation use?

Timber stands affected by the current spruce budworm outbreak will suffer various types and degrees of damage to visual quality of forest landscapes. Treatment would avert most of the future predicted loss due to the current outbreak.

5. What are the economic implications of potential alternatives?

The potential losses in timber growth and yield due to foliage loss are of concern. Visual resources are also affected by spruce budworm as foliage becomes red or trees die. This may have an effect on the local economies of small communities dependent, in part, upon recreation income. Suppression projects bring dollars to the local economy by creating employment opportunities for local citizens and purchasing goods and services.

6. What are the effects on human health associated with treatment using insecticides?

It is recognized that some segments of the public have concerns about pesticide use. It is perceived that these insecticides either pose an immediate hazard to human health, or have the capacity to cause health problems in the future.

7. How effective are available treatment methods in reducing the insect population? (Efficacy)

The efficacy of *B.t.* and other pesticides is directly related to the method of application, weather, and timing. High quality *B.t.* applications, as well as high quality carbaryl applications, are likely to suppress budworm populations below an average of 1 larva per branch tip.

8. What is the timeliness of treatment for this and future outbreak cycles?

Concerns have been raised about the time lapse between the discovery of the outbreak and the start of treatment. What is the most effective timing of treatment? Can early treatment stop widespread infestation?

Alternatives, Including the Proposed Action

This Environmental Impact Statement (EIS) considers four different ways of managing western spruce budworm populations and a "No Action" Alternative.

Alternative A (No Action)

This Alternative allows no intervention in the western spruce budworm infestation cycle. The epidemic would run a course subject only to natural, unpredictable controls. Western spruce budworm activity would be monitored annually. An aerial "sketchmap" survey would determine the extent of visible defoliation. The No Action Alternative forms a baseline against which all other Alternatives are compared.

Alternative B

This Alternative provides for a direct suppression strategy using the biological insecticide *B.t.* only. Suppression projects would be designed to protect those timber, recreation, and visual resources which are expected to sustain unacceptable damage. Treatment would involve the aerial application of *B.t.* to selected areas.

Alternative C

This Alternative prescribes a direct suppression strategy which requires application of the chemical insecticide 'carbaryl'. At this time, carbaryl is recognized as the most effective chemical insecticide available for suppressing budworm populations. It is registered with the Environmental Protection Agency (EPA) as safe for forest application.

Application of carbaryl would involve aerial "broadcast" treatment of infested areas. A strip of untreated vegetation would always be left adjacent to streams and around other bodies of water when this chemical is used.

Alternative D

This Alternative provides for the use of either *B.t.* or carbaryl. Alternative D proposes suppression projects which would protect resources at risk of unacceptable damage. *B.t.* application would be allowed adjacent to but not over streams and other bodies of water. Treatment with carbaryl would be allowed over treatment areas in special instances, but untreated buffer zones would be maintained around streams and other bodies of water. Whether carbaryl or *B.t.* is used in a treatment area would be determined on a site specific basis. The proximity of human habitation or

the frequency of human use in proposed treatment areas will be considered in every decision.

Alternative E (Preferred)

This Alternative was developed in consideration of public comments and concerns which addressed the Draft EIS. It is largely a composite of elements described in Alternatives B and D. This Alternative provides for direct suppression of budworm infestations. The biological insecticide *B.t.* is defined as the treatment of choice. However, carbaryl may be used in the event that *B.t.* is unavailable or is expected to be ineffective in site-specific instances. Situations in which the use of carbaryl might be warranted are:

- When *B.t* is not available.
- Where the proven effectiveness of carbaryl is shown to be substantially better than prescribed solutions of *B.t.*
- When high value stands are infested by rapidly expanding western spruce budworm populations and effective insect control requires an insecticide that has both contact and residual properties.
- In research and pilot test projects designed to evaluate unproven formulations or lower dosages.
- When a Regional Entomologist's analysis recommends its use.

The decision to use *B.t.* or carbaryl within treatment areas will be made in project-specific environmental analysis. The resources and environment within each area will be considered in the decision making process. Human habitation and the frequency of use within the analysis areas will be given primary consideration. Formulations of *B.t.* could be adjacent to but not over streams or other bodies of water. Treatment with carbaryl would require that an untreated buffer strip be maintained along streams or around other bodies of water.

A comparison of these Alternatives follows:

Comparison Of Alternatives

Planning Question #1:

What are the hydrological effects of treatment and nontreatment?

Alt. A. (No Action)	No significant increase in annual streamflow or peak discharge is anticipated as a direct result of defoliation and mortality. Cumulative effects of extensive management activities, combined with defoliation, could produce significant increases in annual streamflow. These increases could degrade water quality. Defoliation and mortality could promote slight increases in water temperature in some stream segments.
Alt. B. (Use of *B.t.* only)	This Alternative would reduce defoliation and lessen impacts described in the No Action Alternative.
Alt. C. (Use of Carbaryl only)	This Alternative would reduce defoliation and lessen impacts described in the No Action Alternative.
Alt. D. (Use of *B.t.* and/or Carbaryl)	This Alternative would reduce defoliation and lessen impacts described in the No Action Alternative.
Alt. E. (*B.t.* as primary insecticide)	This Alternative would reduce defoliation and lessen impacts described in the No Action Alternative.

Planning Question #2:

What are the effects of Alternatives on fuels and fire?

Alt. A. (No Action)	A minimum impact on fuel loading in areas where only scattered mortality has occurred; severe defoliation and high levels of mortality will result in significant increases to fuel loading; fire intensity is expected to be high in continuous areas of mortality; fire line construction wil be slowed by heavier fuels.
Alt. B. (Use of *B.t.* only)	Short-term potential for heavy fuel buildup would be reduced or eliminated; scattered mortality would occur; existing fuel loading would not be significantly increased; projected fire intensity and fireline construction rates would remain constant.
Alt. C. (Use of Carbaryl only)	Short-term potential for heavy fuel buildup would be reduced or eliminated; scattered mortality would occur; existing fuel loading would not be significantly increased; projected fire intensity and fireline construction rates would remain constant.
Alt. D. (Use of *B.t.* and/or Carbaryl)	Short-term potential for heavy fuel buildup would be reduced or eliminated; scattered mortality would occur; existing fuel loading would not be significantly increased; projected fire intensity and fireline construction rates would remain constant.

Alt. E. (*B.t.* as primary insecticide)	Short-term potential for heavy fuel buildup would be reduced or eliminated; scattered mortality would occur; existing fuel loading would not be significantly increased; projected fire intensity and fireline construction rates would remain constant.

Planning Question #3:

What are the effects of Alternatives on fish, wildlife, and domestic animals?

Alt. A. (No Action)	Implementation of this Alternative would result in no adverse impacts to fish or animals.
Alt. B. (Use of *B.t.* only)	Implementation of this Alternative would result in no significant impacts on fish or animals. Some resources may benefit slightly.
Alt. C. (Use of Carbaryl only)	Implementation of this Alternative may result in significant impacts to some resources. Specifically, some species of small mammals, birds, and insects may be adversely affected by the toxicological properties of carbaryl or it's carriers, diesel oil and kerosene.
Alt. D. (Use of *B.t.* and/or Carbaryl)	Implementation of this Alternative, in compliance with prescribed mitigation measures, may result in minor impacts to some resources. Significant impacts would probably be mitigated by the use of *B.t.* in sensitive ecosystems.
Alt. E. *(B.t.* as primary insecticide)	Under ordinary circumstances implementation of this Alternative would not result in significant impacts to other resources. Some resources may benefit slightly. Implementation with carbaryl, in compliance with established mitigation measures, may result in minor impacts to some resources. Significant impacts would probably be mitigated by the use of *B.t.* in sensitive ecosystems.

Planning Question #4:

What effects would implementation of the Alternatives have on viewsheds and recreational use?

Alt. A. (No Action)	Severe defoliation will result in color and texture changes for a decade or more; changes in visual quality could result in decreased recreational use, with a corresponding impact on the recreation economy.
Alt. B. (Use of *B.t.* only)	Treatment would provide short-term protection of foliage; changes to color and texture of the landscape are reduced but not eliminated; cumulative mortality and top-kill would be reduced; only slight reductions in recreation use would be expected; a forest with tree species susceptible to continued defoliation would be maintained.
Alt. C. (Use of Carbaryl only)	Treatment would provide short-term protection of foliage; changes to color and texture of the landscape are reduced but not eliminated; cumulative mortality and top-kill would be reduced; only slight reductions in recreation use would be expected; a forest with tree species susceptible to continued defoliation would be maintained.

Alt. D. (Use of *B.t.* and/or Carbaryl)	Treatment would provide short-term protection of foliage; changes to color and texture of the landscape are reduced but not eliminated; cumulative mortality and top-kill would be reduced; only slight reductions in recreation use would be expected; a forest with tree species susceptible to continued defoliation would be maintained.
Alt. E. (*B.t.* as primary insecticide)	Treatment would provide short-term protection of foliage; changes to color and texture of the landscape are reduced but not eliminated; cumulative mortality and top-kill would be reduced; only slight reductions in recreation use would be expected; a forest with tree species susceptible to continued defoliation would be maintained.

Planning Question #5:

What are the economic implications of the Alternatives?

Alt. A. (No Action)	Long-term reduction in future supply of wood fiber; short-term increase of logs for manufacturing due to salvage operations.
Alt. B. (Use of *B.t.* only)	Long-term supply of wood fiber maintained; short-term increase in local demand for goods and services. Short-term increase due to spray operation.
Alt. C. (Use of Carbaryl only)	Long-term supply of wood fiber maintained; short-term increase in local demand for goods and services. Short-term increase due to spray operation.
Alt. D. (Use of *B.t.* and/or Carbaryl)	Long-term supply of wood fiber maintained; short-term increase in local demand for goods and services. Short-term increase due to spray operation.
Alt. E. (*B.t.* as primary insecticide)	Long-term supply of wood fiber maintained; short-term increase in local demand for goods and services. Short-term increase due to spray operation.

Planning Question #6:

What are the effects on human health associated with treatments using B.t. and other chemicals?

Alt. A. (No Action)	This Alternative would have no effect on human health, since the Alternative prescribes no chemical or biological insecticides.
Alt. B. (Use of *B.t.* only)	This Alternative presents the least risk of the direct suppression Alternatives. The use of *B.t.* poses little risk of acute or chronic effects on human health.
Alt. C. (Use of Carbaryl only)	This Alternative presents the highest risk to human health of any direct suppression Alternative being considered. Carbaryl poses a human health risk only in the event of accident. The petroleum-distillate carrying agents (kerosene and diesel oil), commonly used for application, present a risk under routine worst-case conditions and in the event of accidents.
Alt. D. (Use of *B.t.* and/or Carbaryl)	This Alternative presents human health risks less that Alternative C, but greater than Alternative B. The level of risk would be reduced in proportion to the extent that *B.t.* is used instead of carbaryl.

Alt. E.
(*B.t.* as primary insecticide)

This Alternative would generally present minimum risk to human health. The use of *B.t.* poses little risk of acute or chronic effects on human health. Risk to human health would be reduced to the extent that *B.t.* is applied in place of carbaryl.

Planning Question #7:

How effective are the treatment methods?

Alt. A.
(No Action)

No effect on achieving lasting budworm population reductions.

Alt. B.
(Use of *B.t.* only)

Applications are likely to suppress budworm populations to below identified threshold levels; populations unlikely to develop a tolerance; resurgence and reinvasion are not anticipated.

Alt. C.
(Use of Carbaryl only)

Applications are likely to suppress budworm populations to below identified thresholds; budworm populations can develop a tolerance to carbaryl applications; budworm reinvasion from buffers and other adjacent untreated areas is possible; inadvertent sublethal doses can stimulate resurgence of populations.

Alt. D.
(Use of *B.t.* and/or Carbaryl)

Flexibility to use either *B.t.* or carbaryl as the situation warrants, is likely to suppress budworm populations to below identified threshold levels; use of carbaryl has potential to influence occurrence of reinvasion and/or resurgence.

Alt. E.
(*B.t.* as primary insecticide)

Flexibility to use either *B.t.* or carbaryl as the situation warrants, is likely to suppress budworm populations to below identified threshold levels; use of carbaryl has potential to influence occurrence of reinvasion and/or resurgence.

Planning Question #8:

What is the timeliness of treatment for this and future outbreak cycles?

Alt. A.
(No Action)

Implementation of this Alternative would allow budworm infestations to follow a natural course. It would have no effect on the frequency of future epidemics.

Alt. B.
(Use of *B.t.* only)

Implementation of treatments prescribed in this Alternative must be timely. Sufficient time must have elapsed to indicate that the outbreak is persisting, in spite of natural controls. Earlier treatment would not have prevented the "spread" of budworm infestation. The application of *B.t.* should have no effect on future outbreaks.

Alt. C.
(Use of Carbaryl only)

Implementation of treatments prescribed in this Alternative must be timely. Sufficient time must have elapsed to indicate that the outbreak is persisting, in spite of natural controls. The application of carbaryl (with buffers where appropriate) may have an effect on the ability of budworm populations to reinvade and resurge, thus affecting future outbreaks.

Alt. D.
(Use of *B.t.* and/or Carbaryl)

Implementation of treatments prescribed in this Alternative must be timely. Sufficient time must have elapsed to indicate that the outbreak is persisting, in spite of natural controls. The application of sublethal dosages of carbaryl may stimulate budworm populations and contribute to the resurgence of vigorous populations.

Alt. E. (B.t. as primary insecticide)	Implementation of treatments prescribedin this Alternative must be timely. Sufficient time must have elapsed to indicate that the outbreak is persisting, in spite of natural controls. Earlier treatment would not have prevented the "spread" of budworm infestation. The application of *B.t.* should have no effect on future outbreaks. The application of sublethal dosages of carbaryl may stimulate budworm populations and contribute to the resurgence of vigorous populations.

Environmental Consequences

Environmental consequences result when changes are made to ecosystems; changes which may be brought about either by commission or omission. Under each of the action Alternatives, western spruce budworm populations would be managed using either a biological or a chemical insecticide, or a combination of both.

The EIS prescribes that a project-specific environmental analysis will be conducted for each proposed budworm management project. The appropriate disclosure document will be prepared for each year's proposed treatment(s) and made available for public review. This analysis tool would consider individual projects, and would involve the public in the decision making process. If the No Action Alternative is selected, monitoring of the current budworm epidemic will continue.

The following section summarizes the most significant environmental impacts projected to result from implementation of each of the alternatives. A complete analysis of the effects can be found in chapter IV and appendix F of the Final Environmental Impact Statement.

Water Quality/Quantity

Alternative A - No Action

Alternative A, the No Action Alternative, would result in few significant impacts to water quality and quantity. In watersheds where there are extensive, ongoing management activities, the cumulative impacts of these activities and budworm defoliation could produce a significant increase in annual streamflow.

Alternatives B, C, D and E

Implementation of Alternatives B, C, D and E would reduce defoliation and eliminate the slight impacts described under the No Action Alternative. Reduced defoliation would also lessen the cumulative impacts described under Alternative A.

Plant Communities

Alternative A - No Action

Over time, the No Action Alternative would allow mortality which would open pockets in the canopy. The cumulative effect of this Alternative would be a gradual change of stand composition.

Alternatives B, C, D and E.

The action Alternatives would tend to keep timber stands and attendant plant communities in their present successional state.

Timber

Timber stands affected by the current spruce budworm outbreak have sustained various types and degrees of loss in wood fiber production. Diminished wood fiber production is primarily a result of radial growth loss. Additional reductions are due to top-kill, tree deformity, and tree mortality. Reduced seed production may also be attributed to spruce budworm damage.

Alternative A - No Action

The maximum amount of budworm-caused radial growth loss would continue until natural regulating factors caused a population collapse. In the long term, as the host trees are replaced by more resistant species, growth loss due to the infestation would become less. The amount of tree mortality will vary with the intensity and degree of infestation. Scattered mortality may be beneficial in some instances. Local woodcutters, for example, may enjoy short-term gains from the salvage of dead trees. In some stands, mortality of budworm host trees may actually accelerate the growth of non-host species.

The maximum amount of top-kill and deformity caused by a full-term budworm outbreak would be experienced. Western spruce budworm infestations have been shown to cause damage to the cones of Douglas-fir, grand fir, and western larch. Under this Alternative, reduced seed production would continue until epidemic populations of spruce budworm collapse naturally. As a direct result, natural regeneration of the host species would be reduced.

Alternatives B, C, D and E.

Projections show that implementation of these Alternatives would result in a level of budworm population control that would avert most additional loss of wood fiber production caused by the current outbreak. Under any of the action Alternatives, mortality would not be expected in treated stands which have sustained no previous damage.

Under these Alternatives, the top-kill and tree deformity described in Alternative A would be averted to some degree. Those trees which have not already sustained top-kill could be successfully treated. Application of *B.t.* and/or carbaryl to infested areas could avert much of the budworm-caused seed damage. Seed production would therefore be greater

than under the No Action Alternative. The chances of establishing stands through natural regeneration would be improved.

Fire and Fuels

Alternative A - No Action

The No Action Alternative would have little effect on fuel loading in areas where only scattered mortality has occurred. However, the extensive defoliation which results in increased mortality would cause a significant rise in fuel loading.

Alternatives B, C, D, and E

Alternatives B, C, D and E would reduce or eliminate the short-term potential for fuel buildup. Only scattered mortality would be expected.

Western Spruce Budworm

Alternative A - No Action

Implementation of the No Action Alternative would not result in lasting reductions in budworm populations. If the No Action Alternative were selected, the outbreak would be allowed to run a natural course of rise, peak, and decline. Weather, parasites and predators, disease, and food supply would be allowed to exert their normal influence over the outbreak populations. Implementation of this Alternative would not preclude the long-range prevention of budworm outbreaks through current and future forest management practices.

Alternative B

Applying *B.t.* is not considered likely to prolong the outbreak. Application should have no effect on natural enemies. When populations of budworm are suppressed, the natural enemies should be able to again exert their controls.

Resurgence is expected to be less of a problem under this Alternative than under Alternatives C and D, because *B.t.* would not stimulate vigorous population growth if areas receive sublethal doses.

It is unlikely that budworm populations would develop a tolerance to *B.t.* applications. Quality *B.t.* applications would be likely to suppress budworm populations to below the established threshold density of 1 larva per branch tip.

Alternative C

Applying carbaryl would not likely prolong the outbreak, and would have only minor effects on the budworm's natural enemies.

Resurgence is a potential problem with the use of carbaryl. Studies show budworm populations can develop a tolerance to carbaryl applications. Quality carbaryl applications would be likely to suppress budworm populations below the established threshold density of 1 larva per branch tip.

Alternative D

The option of using either *B.t* or carbaryl would allow managers to select the one which best meets the needs of a particular situation. When there is no practical difference, or no concern about potential effects, the choice could be made for economic or other reasons.

Alternative E

Implementation of this Alternative would result in effects similar to those described under Alternative B. The primary difference between these two Alternatives is that under Alternative E carbaryl could be used, but only in very limited instances.

Wildlife

Alternative A - No Action

Taking no action, and allowing continued spruce budworm infestation, will result in minor reductions of hiding and thermal cover for big game. Offsetting these losses will be an increase of forage production associated with reduced tree crown cover. Both effects are expected to be of little consequence.

Alternative B

Since *B.t.* is not a broad-spectrum insecticide and affects only lepidopterans (moths and butterflies), expected impacts upon terrestrial organisms are slight. Some nontarget moth and butterfly species, which are in the larval stage at the time of treatment, may be at risk of experiencing population reductions for a year or two.

Implementation of Alternative B would result in minimal disturbance of wildlife populations, and would have little adverse impact to survival and abandonment of young.

Alternative C

No realistic doses of carbaryl exceed the EPA risk criterion of 1/5 LD_{50}. Alternative C would not present a substantial risk to wildlife populations.

Wildlife exposures are far below the EPA risk levels for diesel oil and kerosene and, under this program, there would be no risk to wildlife populations from their use.

Alternative D

It is assumed *B.t.* will be applied on sensitive areas, e.g., riparian/watershed, and carbaryl will be used on all other areas. The most substantial difference between this alternative and the carbaryl-only alternative is the reduced impact on the aquatic ecosystem.

Alternative E

The biological insecticide *B.t.* is the treatment of choice. Wildlife impacts should be minor, essentially the same as for Alternative B. If use of carbaryl is warranted, the effects on wildlife would be similar to those expected under Alternative D.

Threatened, Endangered, and Sensitive Species

Alternative A - No Action

This Alternative would have no known negative impact to threatened, endangered or sensitive species.

Alternative B

This Alternative has potential to impact threatened, endangered, and sensitive plant and animal species in a limited manner. The potential for direct impact would probably result from mechanical activities associated with aerial application. Negative impacts are not expected to be substantial.

Alternative C

Under this Alternative (the use of carbaryl only) the potential effects on threatened, endangered, and sensitive species are greater than those expected under the other action Alternatives. However, negative impacts on these species is not expected to be substantial.

Alternative D and E

The effect on threatened, endangered, and sensitive species would be similar to that described for *B.t.* Potential for direct impact would be greatest from mechanical activities associated with the aerial application of insecticide. Negative impacts are not expected to be substantial.

Fisheries/Aquatic Ecosystem

Alternative A - No Action

Most data indicate that even with heavy infestations of spruce budworm, most tree defoliation would be less than 100 percent, while stem mortality over the outbreak area would be less than 3 percent. Given these values, it is unlikely that water temperatures of streams in affected areas will be significantly altered.

The No-action Alternative, having minimal adverse impacts on water quality, would have similar minimal effects on fisheries. Aquatic invertebrates would not be affected by the No-action Alternative. This alternative would have the least impact or risk of impact upon aquatic invertebrates and fish.

Alternative B

Few toxic effects have been reported in studies of aquatic species exposed to *B.t.*

B.t. treatments in streamsides would pose no threat to aquatic organisms unless a direct spill occurred. Concentrations in streams resulting from normal treatment would be far below the levels that proved toxic to blackfly and mosquito larvae. The adverse effects of spills would be short-term and limited to relatively small stream reaches.

The risk of spills, and subsequent contamination of water with fuel and/or large quantities of *B.t.*, is very low.

Alternative C

In most cases, carbaryl poses low risk to fish in ponds or streams when a 500 foot buffer strip is maintained. If the body of water is very shallow (6 inches or less in depth), there may be moderate risks to some trout species. Aquatic invertebrates, such as water fleas, stoneflies, and scuds, are at significant risk if the estimated environmental concentrations calculated in this analysis are present for anything but a transient time period, as would be the case in shallow ponds or very slow-moving streams.

Diesel Oil and Kerosene would pose significant risks to all representative aquatic species if the concentrations calculated in this risk assessment were not transient.

Alternative D

The impact on fisheries and aquatic systems is expected to be somewhat less than effects from Alternative C.

Alternative E

The impacts on fisheries and aquatic systems is expected to be similar to Alternative B in most cases. If carbaryl is used, the impacts expected to the aquatic system would be somewhat less than expected for Alternative D.

Visual Resources

Alternative A - No Action

The impact of continued defoliation on visual quality and the Forest users' experience will be greatest in the areas where severe defoliation is found. The cumulative effect of the No Action Alternative would be an increase in the acres of defoliation and visual change that occur each year; changes which would continue until budworm populations are reduced by natural events.

Alternatives B, C, D and E

Short-term protection of foliage by using *B.t.* or carbaryl reduces the changes in color and texture that occur on the landscape, but does not eliminate them. The cumulative effect of implementing Alternatives B, C, D or E would be an annual reduction in acres severely defoliated.

Human Health

A risk assessment was done to assess the risks to human health of using the chemical insecticide, carbaryl and the biological control agent, *Bacillus thuringiensis (B.t.)* for controlling western spruce budworm in Region 6.

The risk assessment also addressed the human health risks of a number of chemicals associated with the application of the insecticides and *B.t.* Because carbaryl is commercially formulated (as Sevin 4-Oil) with kerosene, and because diesel oil is used as a carrier in the application of Sevin 4-Oil, the risks of these two petroleum distillates were analyzed.

In essence, the risk assessment estimated doses people may get from applying the insecticides (worker doses) or from being near an application site (public doses), then compared those estimated doses with doses shown to cause no observed effects in tests on laboratory animals. The risk assessment employed three principal analytical elements: hazard analysis, exposure analysis, and risk analysis.

The hazard analysis identified the toxic properties of *B.t.*, and of each chemical insecticide originally considered for the program, in a thorough review of available toxicological studies.

The exposure analysis analyzed a range of possible exposures--from realistic to extreme--using three types of scenarios:

Typical application scenarios (routine-typical) to estimate worker and public doses that may reasonably be expected to occur during routine operations.

Worst-case application scenarios (routine worst-case) to give very high dose estimates not likely to be exceeded except in the case of an accident.

Accident scenarios to estimate public and worker doses from exposure to spray mix or concentrate, directly or in spills into drinking water.

Risk analysis evaluated the risk of acute and chronic health effects by comparing estimated doses to no-observed-effect-levels (NOEL's) in laboratory animal studies, using a margin of safety (MOS). The MOS is calculated by dividing the NOEL by the estimated dose. A benchmark risk MOS of 100 was used to assess the likelihood of effects. Doses that are 100 times lower than the laboratory NOEL are assumed to present a low risk of human health effects. Risk increases as the estimated dose approaches the laboratory toxicity level; that is, as the MOS decreases.

There were a number of data gaps and areas of uncertainty identified in the risk assessment. In each of those areas, a conservative approach was used or a worst-case analysis was done that tended to increase the estimates of risk to err on the side of safety.

Hazard Analysis Results

This section summarizes the toxic properties of carbaryl, diesel oil, kerosene, and *Bacillus thuringiensis*.

Reproductive/Developmental Toxicity: Carbaryl is teratogenic in many test species, with lowest NOELs found in dogs, but again, the dog effects are not assumed to extrapolate to humans. An inhalation teratology study in which rats were exposed to diesel fuel on days 6 through 15 of gestation did not result in any significant teratogenic effects. The kerosene reproductive NOEL of 751 mg/kg/day is based on the diesel oil reproductive NOEL because no reproductive data exist for kerosene and it is similar in composition to diesel oil. The literature contains no data about the reproductive or teratogenic effects of *B.t.*

Carcinogenicity: The review of 10 chronic toxicity studies, and the absence of significant tumor incidence at 400 ppm in rats and mice, has provided sufficient evidence for EPA to conclude "that carbaryl is not oncogenic in experimental animals". The cancer potency of diesel oil is based on two carcinogenic constituents, benzo-a-pyrene (BaP) and benzene, known to be present in low concentrations in diesel and fuel oils. The carcinogenic potential of kerosene is similar to that of diesel oil since the same substances (BaP and benezene) are responsible in both cases. Kerosene's carcinogenicity is assumed to be the same as that of diesel oil. The literature contains no data about the carcinogenic potential of *B.t.*

Mutagenicity: EPA has concluded that carbaryl does not pose a mutagenic risk because only weak mutagenic responses have been measured and there is no evidence demonstrating the ability of carbaryl to reach germinal tissue; hence, germ cells should not be affected. Diesel oil is considered mutagenic in this risk assessment because of the presence of polycyclic aromatic hydrocarbons (PAHs) that are known or suspected mutagens. Because kerosene contains polycyclic aromatic hydrocarbons (PAH's), as diesel oil does, it is assumed to present a mutagenic risk in this risk assessment. All test materials for *Bacillus thuringiensis* were negative in all systems.

Exposure Analysis Results

Margins of safety (MOS') were computed for workers and the public for routine operations (typical and worst-case exposures), and for accidents, for carbaryl, diesel oil, kerosene, the combined petroleum distillates, and for *B.t.* The margins of safety were computed by dividing the laboratory-determined NOEL's by the doses listed in the risk assessment.

Risk to the Public

Margins of safety for the public in routine-typical spraying are greater than 100 for systemic effects for the three chemicals, for the combined petroleum distillates, and for *B.t.* Margins of safety for reproductive effects for the three chemicals also are all greater than 100. These large margins of safety mean that members of the public could be repeatedly exposed to these levels and suffer no adverse effects.

These results indicate that no systemic or reproductive effects are likely to result from the use of carbaryl or *B.t.* in spruce budworm suppression operations.

The routine worst-case scenarios were intended to indicate the upper bounds for public exposure to insecticide applications in the Pacific Northwest. The low probability of occurrence of each assumed event must be emphasized. It is extremely unlikely that anyone would receive a dose as high as those estimated here.

MOS's for reproductive effects are greater than 100 for diesel oil, kerosene and *B.t.* for the routine worst-case exposures. MOS's for diesel oil and the combined petroleum distillates are greater than 100 except for dermal and inhalation exposure to drift. These results indicate there is some slight risk of effects from carbaryl drift and from diesel oil/petroleum distillate drift exposure.

The extent of effects would depend upon an individual's duration of exposure and any precautionary measures that were taken. For example, if people gathered a bushel of berries from a spray area, did not wash them but froze them, and then ate them every day for a month, they might experience ill effects such as nausea and dizziness. However, if people bathed after being in the forest or washed food items before eating them, the doses would drop and substantially increase the margins of safety.

Risk to Workers

From Routine Operations: In the routine-typical exposures, all categories of workers, except backpack applicators, applying carbaryl, kerosene, and *B.t.* have MOS's greater than 100.

Carbaryl, diesel oil, and the combined petroleum distillates have MOS' less than 100 for routine worst-case exposure. The probability of workers receiving repeated daily doses as high as predicted here is extremely low. Therefore, even if a worker felt ill for a day or so from an unusually high dose, permanent damage would be unlikely.

Risk Analysis Results

A worst-case analysis for cancer was conducted for carbaryl, diesel oil, kerosene, and the petroleum mixture. There are no data on *B.t.* carcinogenicity, so no quantitative cancer risk assessment could be performed for this material.

Cancer Risks

Results for carbaryl, diesel oil, kerosene, and petroleum distillates indicate that no member of the public is at a greater than 2.3 in 100 million risk of cancer from routine exposures.

Workers are not at cancer risk greater than 1 in 1 million for any task or chemical. Cancer risks for worker accidents also do not exceed 1 in 1 million for any chemical.

Risk of Effects from *B.t.* Contaminants (Bioburden)

Humans exposed to *B.t.* in spruce budworm suppression operations may be at some low level of risk from eye or skin irritation or infection, but are not at risk of any systemic effects from *B.t.*

Carbaryl was nonmutagenic in the majority of assays conducted and was nononcogenic in all of the carcinogenicity tests performed; therefore, it can be assumed that its germ cell mutagenic risk is slight to negligible. Kerosene and diesel oil both contain PAH's and are considered to be possibly mutagenic.

Cumulative Effects

No individual member of the public is likely to receive repeated exposures to any of the insecticides because of the remoteness of most treatment units, the widely spaced timing of repeated treatments, and the use of a variety of insecticides for different purposes.

Summary Of Human Health Effects Of The Alternatives

Alternative A - No Action

This alternative would have no effect on human health because no chemical insecticides or biological controls would be used.

Alternative B

This alternative presents the lowest risk of all the alternatives except the No-action Alternative.

Alternative C

Carbaryl poses a human health risk only in the case of accidents. The petroleum distillates, kerosene and diesel oil, associated with carbaryl application do present a risk under routine worst-case conditions and in accidents. Therefore, this alternative presents the highest risk to human health of the five alternatives. The petroleum distillates present a degree of uncertainty in the risk evaluation because of lack of data on their toxicity. Should additional data become available, their risks would be reassessed.

Alternatives D and E

Human health risks of this alternative would be less than alternative C, but greater than alternative B. The level of risk would be proportionate to the ratio of *B.t.* and carbaryl used. Risks would be reduced to the extent that *B.t.* is used instead of carbaryl.

Economic Efficiency And Local Impacts

Alternative A - No Action

Under the No Action Alternative, a long-term reduction in the future supply of fiber is projected for most analysis units.

Alternatives B, C, D and E

To the extent funding is available, investment in direct suppression with *B.t.* or carbaryl would be made in analysis units which offer the greatest net financial and intangible benefits.

Social Factors

The effects of implementation of any Alternative on consumers, citizens' civil rights, minority groups, and women are estimated to be insignificant. Generally, these effects are related to the supply of wood fiber and the resulting cost of wood products. Primary and secondary employment associated with the manufacture of wood products is also a consideration.

Irreversible Or Irretrievable Effects

No irreversible commitments of resources have been identified. Implementation of the Preferred Alternative would avert most of the total net timber loss which could occur from not treating the infestation. Recouping all of the estimated loss could be accomplished only with a highly successful treatment program which treated all of the infected stands.